From:	Wetmore, Cynthia
To:	Spencer Lapiers
Cc:	Grigorieff Mike; Collins Jake; Dinello Jaime; Mpalmer@demaximis.com; MARTINEZ, YARISSA
Subject:	RE: Montrose TGRS: Vacuum Testing of Western Well Field Injection Wells
Date:	Tuesday, October 16, 2018 7:57:00 AM
Attachments:	image001.png image003.png image004.png

Spencer, EPA has no comments. Consider this approved.

Cynthia Wetmore, Operation and Scientific Support Section
US.EPA, Region IX, Superfund Division
75 Hawthorne Street, San Francisco, 94105
(415)972-3059

From: Spencer Lapiers [mailto:slapiers@demaximis.com]
Sent: Monday, October 15, 2018 12:54 PM
To: Wetmore, Cynthia <Wetmore.Cynthia@epa.gov>
Cc: Grigorieff Mike <Mike.Grigorieff@CH2M.com>; Collins Jake <jcollins@demaximis.com>; Dinello Jaime <jdinello@demaximis.com>; Mpalmer@demaximis.com; MARTINEZ, YARISSA <martinez.yarissa@epa.gov>
Subject: RE: Montrose TGRS: Vacuum Testing of Western Well Field Injection Wells

Cynthia,

We have updated the proposed vacuum testing procedures to reflect ex-situ testing of injection well piping. The attached procedures will be submitted along with the complete revised version of the Restart Plan, however we wanted to present these to you now for consideration as we are making arrangements to mobilize next week to begin installation of the backflushing system in G-IW-3.

We would like to have these procedures reviewed and approved before the end of this week, if at all possible, to facilitate testing next week.

Please reach out with any questions.
We would be happy to set up a call to discuss, or we can possibly walk through this during tomorrow's weekly status call.

Thanks

Spencer Lapiers, CHMM
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>>> "Wetmore, Cynthia" <Wetmore.Cynthia@epa.gov> 10/1/2018 3:26 PM >>>
Jake,

EPA approves the procedure below with the following exception:

- Please remove the last sentence in the procedures.

Please include the revised procedures as Attachment H in the Re-start Work Plan.

Approved procedures are below:

Vacuum Testing Procedure

EPA proposed air entrainments within the injection well piping as one causal factor for injection well specific capacity loss. One potential route of air entry into the injection process could be leaks within the piping fitting connections that would allow introduction of atmospheric air into the injection well head and injection drop piping. In order to confirm the integrity of the injection well head and injection drop piping, a vacuum test is proposed to be conducted on all piping downstream of the automated flow control valve at the injection well. This piping incidentally contains the greatest number of threaded and/or flanged connection within the piping system, so would be the likely route of air introduction, if occurring.

A simple testing procedure has been developed to verify piping integrity.

Test Setup

1. Verify the automated flow control valve (electrically actuated valve) is fully closed.
2. Verify that all other manual valves are in their normal status (normally open or normally closed).
3. Verify that air release valves have intact/installed check valves installed on their respective exhaust ports.
4. Connect vacuum gauge to existing sample port on injection well piping string.
5. Remove/plug and/or valve off existing pressure gauge and pressure transducer (Note: Taking pressure gauges and pressure transducers to negative pressures, if not rated for this service, may damage the pressure gauge and/or transducer).
6. Connect vacuum pump with non-collapsible tubing to exhaust port check valve of injection stinger air release valve. Vacuum supply should be able to be valved off from pump (e.g. ball valve placed between vacuum pump and exhaust port connection) after establishing required vacuum.

Note: It is important to modify the injection well piping as little as possible for testing purposes (e.g. removing/plugging air release valves, pressure ports) so that the connections associated with the injection wellhead under normal operations are as intact as possible to limit potential post-test air introduction points.

Test Execution

1. Activate vacuum pump. (Note: Vacuum pump should be capable of developing at least 25" of Mercury ("Hg) vacuum).
2. Continue to remove air and impart vacuum on piping string until vacuum gauge on existing sample port

reads 25" of Mercury.

3. Close valve between vacuum pump and exhaust port. Record vacuum on vacuum gauge. Turn off vacuum pump.
4. Continue to take readings in 5 minute increments until 30 minutes has elapsed.
5. If vacuum is not holding or air is noted to be "sucking" into piping, tighten connections and retest.
6. Upon completion of successful test, remove vacuum gauge, vacuum pump connection, and reestablish normal operating position of all valves.

Note: A successful test will hold with no appreciable change in vacuum over the 30 minutes. The 30 minute test will begin once the vacuum has time to equilibrate in the system. EPA will have a representative onsite during testing to confirm the start and end of the test to concur success or failure. Montrose will make all attempts to conduct the test using the guidelines above.

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From: Jake Collins [mailto:jcollins@demaximis.com]
Sent: Thursday, September 20, 2018 12:04 PM
To: Wetmore, Cynthia <Wetmore.Cynthia@epa.gov>
Cc: mike.grigorieff@CH2M.com; Dinello Jaime <jdinello@demaximis.com>; Mpalmer@demaximis.com; Lapiers Spencer <SLapiers@demaximis.com>; MARTINEZ, YARISSA <martinez.yarissa@epa.gov>
Subject: RE: Montrose TGRS: Vacuum Testing of Western Well Field Injection Wells

Cynthia,

Below you will find the revised procedure for the proposed vacuum testing of the western injection well field wells. Changes are called out in red. This revised procedure addresses comments provided by EPA on August 31, 2018 with the exception of the first six comments. These items were included to provide a holistic picture of the Vacuum Test Advisory and are included in the Root Cause Analysis Advisory subsequently submitted to EPA on 9/5/18. Due to these items not being part of the Vacuum Testing procedure, Montrose will not be responding to these comments at this time. Montrose will respond to EPA comments to the entirety of the Root Cause Analysis advisory and address these six comments accordingly.

Per the meeting held on September 6, 2018, EPA agreed to drop the requirements of the vacuum from 27-inches of mercury vacuum to 25-inches.

Please let me know if you have any questions,
Jake

Vacuum Testing Procedure

EPA proposed air entrainments within the injection well piping as one causal factor for injection well specific capacity loss. One potential route of air entry into the injection process could be leaks within the piping fitting connections that would allow introduction of atmospheric air into the injection well head and injection drop piping.

In order to confirm the integrity of the injection well head and injection drop piping, a vacuum test is proposed to be conducted on all piping downstream of the automated flow control valve at the injection well. This piping incidentally contains the greatest number of threaded and/or flanged connection within the piping system, so would be the likely route of air introduction, if occurring.

A simple testing procedure has been developed to verify piping integrity.

Test Setup

1. Verify the automated flow control valve (electrically actuated valve) is fully closed.
2. Verify that all other manual valves are in their normal status (normally open or normally closed).
3. Verify that air release valves have intact/installed check valves installed on their respective exhaust ports.
4. Connect vacuum gauge to existing sample port on injection well piping string.
5. Remove/plug and/or valve off existing pressure gauge and pressure transducer (Note: Taking pressure gauges and pressure transducers to negative pressures, if not rated for this service, may damage the pressure gauge and/or transducer).
6. Connect vacuum pump with non-collapsible tubing to exhaust port check valve of injection stinger air release valve. Vacuum supply should be able to be valved off from pump (e.g. ball valve placed between vacuum pump and exhaust port connection) after establishing required vacuum.

Note: It is important to modify the injection well piping as little as possible for testing purposes (e.g. removing/plugging air release valves, pressure ports) so that the connections associated with the injection wellhead under normal operations are as intact as possible to limit potential post-test air introduction points.

Test Execution

1. Activate vacuum pump. (Note: Vacuum pump should be capable of developing at least 25" of Mercury ("Hg) vacuum).
2. Continue to remove air and impart vacuum on piping string until vacuum gauge on existing sample port reads 25" of Mercury.
3. Close valve between vacuum pump and exhaust port. Record vacuum on vacuum gauge. Turn off vacuum pump.
4. Continue to take readings in 5 minute increments until 30 minutes has elapsed.
5. If vacuum is not holding or air is noted to be "sucking" into piping, tighten connections and retest.
6. Upon completion of successful test, remove vacuum gauge, vacuum pump connection, and reestablish normal operating position of all valves.

Note: A successful test will hold with no appreciable change in vacuum over the 30 minutes. The 30 minute test will begin once the vacuum has time to equilibrate in the system. EPA will have a representative onsite during testing to confirm the start and end of the test to concur success or failure. Montrose will make all attempts to conduct the test using the guidelines above. However, due to physical constraints based on the well construction, if a vacuum is able to be held at a reasonable lower vacuum (as low as 20"Hg) than the proposed vacuum, the test will be considered a success.

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>>> "Wetmore, Cynthia" <Wetmore.Cynthia@epa.gov> 8/31/2018 10:56 AM >>>
Hi Jake,

At the August 6th meeting, EPA provided Montrose with a suggested procedure for the Vacuum Testing of Western Well Field Injection Wells (attached). EPA's response, below in red, is based on

this information. In addition, EPA has provided a response to Montrose's rationale for why air entrainment is not a significant factor.

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From: Jake Collins [mailto:jcollins@demaximis.com]
Sent: Tuesday, August 28, 2018 1:59 PM
To: Wetmore, Cynthia <Wetmore.Cynthia@epa.gov>
Cc: mike.grigorieff@CH2M.com; Dinello Jaime <jdinello@demaximis.com>; Mpalmer@demaximis.com; Lapiers Spencer <SLapiers@demaximis.com>; MARTINEZ, YARISSA <martinez.yarissa@epa.gov>
Subject: Montrose TGRS: Vacuum Testing of Western Well Field Injection Wells

Cynthia,
We had provided a well fouling root cause analysis table on August 5. On August 6, we met to discuss root causes of well fouling. Per the discussion during the EPA site visit on August 6, a testing protocol to investigate if air entrainment could be a cause of the well fouling issues occurring in the Western Injection Well Field was requested by EPA. Multiple lines of evidence suggest that air entrainment is not a significant factor in the well fouling in the western well field during the December 2017-January 2018 functional testing:

1. During initial injection, elevated DO readings were recorded by the Aqua Troll (installed in G-IW-3 during limited run time in February 2018) until water levels reached 10 – 8 ft below TOF; DO levels then rapidly decreased. If the observed entrained air as evidenced by the elevated DO readings occur each time injection is restarted, multiple restarts could result in air entrainment that could reduce the well capacity as observed.

2. The DO concentrations measured by the Aqua Troll are likely only indicative of atmospheric air being forced into the water column when the injection wells are initially brought online. The rapid decrease in down well DO concentrations would indicate this is a temporary event, and that atmospheric air is not continuously being fed into the injection wells. Please provide the procedures and readings for how the down well DO concentrations were read during injection.

3. Entrained air would be more likely to rise to the surface rather than travel over 60 ft down and into the formation. Based on Jacob's experience at other injection wells, air entrainment is seen as very fine air bubbles that do not rapidly rise to the surface. They rise very slowly and the downhole velocity could easily carry them down to the well screen.

4. During active injection, air release valves and check valves installed on the injection well manifolds were observed to be operating properly. Valves designed to carry fluids shut off to a specified allowed leakage. ANSI defines six different leakage classes for valves in ANSI 70-2. API discusses valve leakage in their standard API 598. Visual observation is not an indication that a valve will not allow some air to pass when it is closed.

5. Air entrainment would be expected to cause a very rapid decrease in injection specific capacity, over a number of hours of continuous injection. This trend has not been observed in the TGRS injection wells after any successive stop/start injection events. However, if air is entrained during the initial injection numerous times, well plugging will occur over time.

6. Injection well drop tubes were constructed with submerged ends to keep the drop tube full or near full during typical operation. Submerging the end of the drop tube does not guarantee the tube will always be full.

However, to eliminate air entrainment as a well fouling contributing factor completely and satisfy EPA's request, Montrose will perform vacuum testing prior to the functional test. Below is a short procedure including test setup and execution.

Please let me know if you have any questions,
Jake

Vacuum Testing Procedure

EPA proposed air entrainment within the injection well piping as one causal factor for injection well specific capacity loss. One potential route of air entry into the injection process could be leaks within the piping fitting connections that would allow introduction of atmospheric air into the injection well head piping. In order to confirm the integrity of the injection well head piping, a vacuum test is proposed to be conducted on all piping downstream of the automated flow control valve at the injection well head. This piping incidentally contains the greatest number of threaded and/or flanged connection within the piping system, so would be the likely route of air introduction, if occurring. EPA had requested to vacuum test the drop tube and fittings.

A simple testing procedure has been developed to verify piping integrity.

Test Setup

1. Verify the automated flow control valve (electrically actuated valve) is fully closed.
2. Verify that all other manual valves are in their normal status (normally open or normally closed).
3. Verify that air release valves have intact/installed check valves installed on their respective exhaust ports.
4. Connect vacuum gauge to existing sample port on injection well piping string.
5. Remove/plug and/or valve off existing pressure gauge and pressure transducer (Note: Taking pressure gauges and pressure transducers to negative pressures, if not rated for this service, may damage the pressure gauge and/or transducer).
6. Connect vacuum pump with non-collapsible tubing to exhaust port check valve of injection stinger air release valve. Vacuum supply should be able to be valved off from pump (e.g. ball valve placed between vacuum pump and exhaust port connection) after establishing required vacuum.

Note: It is important to modify the injection well piping as little as possible for testing purposes (e.g. removing/plugging air release valves, pressure ports) so that the connections associated with the injection wellhead under normal operations are as intact as possible to limit potential post-test air introduction points.

Test Execution

1. Activate vacuum pump. (Note: Vacuum pump should be capable of developing at least 14" of Mercury vacuum). The procedure provided by EPA specified a vacuum of 27-inches mercury.
2. Continue to remove air and impart vacuum on piping string until vacuum gauge on existing sample port reads between 10" and 14" of Mercury. The procedure provided by EPA specified a vacuum of 27-inches mercury.
3. Close valve between vacuum pump and exhaust port. Record vacuum on vacuum gauge. Turn off vacuum pump.
4. Continue to take readings in 5 minute increments until 30 minutes has elapsed.

5. If vacuum is not holding or air is noted to be “sucking” into piping, tighten connections and retest.

6. Upon completion of successful test, remove vacuum gauge, vacuum pump connection, and reestablish normal operating position of all valves.

Note: A successful test will hold vacuum with an acceptable loss of 0.5” of Mercury over the 30 minutes (about 3% loss). The procedure provided by EPA specified no drop in vacuum over 30 minutes. There may be bouncing of vacuum reading due to water table elevation variation on submerged end of injection stinger. Montrose will make all attempts to conduct the test using the guidelines above. However, due to physical constraints based on the well construction, if a vacuum is able to be held at a lower vacuum than the proposed 10 to 14” of Mercury, the test will be considered a success. The procedure provided by EPA specified no drop in vacuum from 27 inches of mercury over 30 minutes for a successful test.